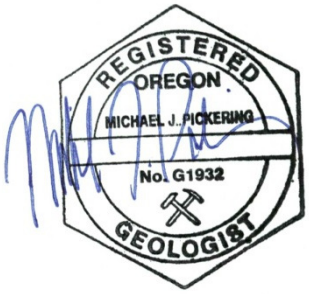
MEMORANDUM



Date: September 25, 2014

To: Kelly Madalinski

From: Michael Pickering
Herb Clough

expires 12/31/2014

Re: Preliminary Stormwater Sub-Basin Sampling Results and Next Steps
Terminal 4 Slip 1 Upland Facility
Portland, Oregon
1267-12

This memorandum presents the preliminary sub-basin stormwater sampling results and recommended next steps on Source Control Measures (SCMs) at Terminal 4 Slip 1 Upland Facility in Portland, Oregon (the Facility; Figures 1). The *Revised Additional Source Control Measure Work Plan* (Apex, 2013; the "Work Plan") presented the work completed to date along with a phased approach for stormwater assessment activities in Basin L and Basin M.

PHASE I ACTIVITIES

Phase I included a comprehensive field verification effort (conducted in July 2013) to confirm stormwater structures were consistent with the Port's Terminal 4 stormwater system base map, qualitative assessment of potential for solids loading to the system, and identification of locations for sub-basin source sampling. A comprehensive sweeping event and cleanout of the stormwater inlets were completed in the fall of 2013. The results of a follow-up round of performance sampling conducted in November 2013 did not indicate an improvement in water quality.

PHASE II SAMPLING ACTIVITIES

To assess what additional SCMs may be effective, the Port completed sampling to understand what area(s) are potentially contributing higher relative contaminant concentrations. This assessment included one event where inline grab samples were collected from selected upstream access points (i.e., manholes and cleanouts) and at the basin discharge (Figure 2). Figure 2 also presents the approximate sub-basins within Basin L and Basin M.

As part of the sampling activities, field parameters were measured to estimate the flow volume. These parameters included the depth of the flow (collected using water sensing paste on a measuring tape) and flow velocity (collected using a digital flow meter where the flow depth was at least two inches; otherwise based on visual observations). In addition, an ISCO auto-sampler recorded the total flow measurement at each outfall sampling location.

PHASE II SAMPLING RESULTS AND EVALUATION

The sub-basin laboratory analytical results for Basin L and Basin M are presented in Table 1 along with the mass loading calculations. A preliminary evaluation of the results are summarized below by basin.

Basin L

- Ten samples were collected at nine locations (8 sub-basins and two "outfall" samples – one grab and one composite).
- Four of the sub-basin samples were submitted for laboratory analysis (polycyclic aromatic hydrocarbons [PAHs], arsenic, and total suspended solids [TSS]).
- Preliminary results indicate 70% of flow, 70% of PAH mass, and 60% of arsenic mass are contributed downstream of STSMH2614.

Basin M

- Seven samples were collected at five locations (4 sub-basins [one with two samples] and two "outfall" samples – one grab and one composite).
- Little or no flow was observed from branches beneath the rail lines at STSMH2720, STSMH2732, and STSMH2729. The portion of the conveyance system that would contribute to these laterals is perforated piping. One sample (STSMH2729 RR) was collected from the lateral that drains the railroad tracks into STSMH2729. The lateral had a very small flow so was not initially analyzed. Although the flow was low, this was the only Basin M sample collected from a branch that had contribution from beneath the adjacent railroad tracks. This sample was analyzed to better understand potential contribution from railroad areas in Basin M. The results were low relative to the other samples suggesting limited contribution from the railroad laterals.
- Preliminary results indicate 90% or more of the PAH/arsenic mass loading comes from upstream of STSMH2720.

RECOMMENDATIONS

The preliminary conclusions are that the majority of contaminant mass contribution is from the upper portion of Basin M and the lower portion of Basin L (Figure 3). Further evaluation of the results and conclusions are ongoing.

Based on these preliminary results, Phase III activities include evaluation of source control measures that may include the following as described in the Work Plan.

- Additional inlet filters in the sub-basins determined to contribute higher relative loading.
- Increased sweeping of the impervious areas (if determined to contribute potential for mass loading).
- Reconfiguration of stormwater system to direct water to treatment swales.
- Replacement of grated-side inlets with filtered, perforated pipe similar to Basin M.

After the preliminary evaluations are completed, the Port will be in communication with DEQ on proposed source control measures.

ATTACHMENTS

Table 1 - Stormwater Sub-Basin Evaluation

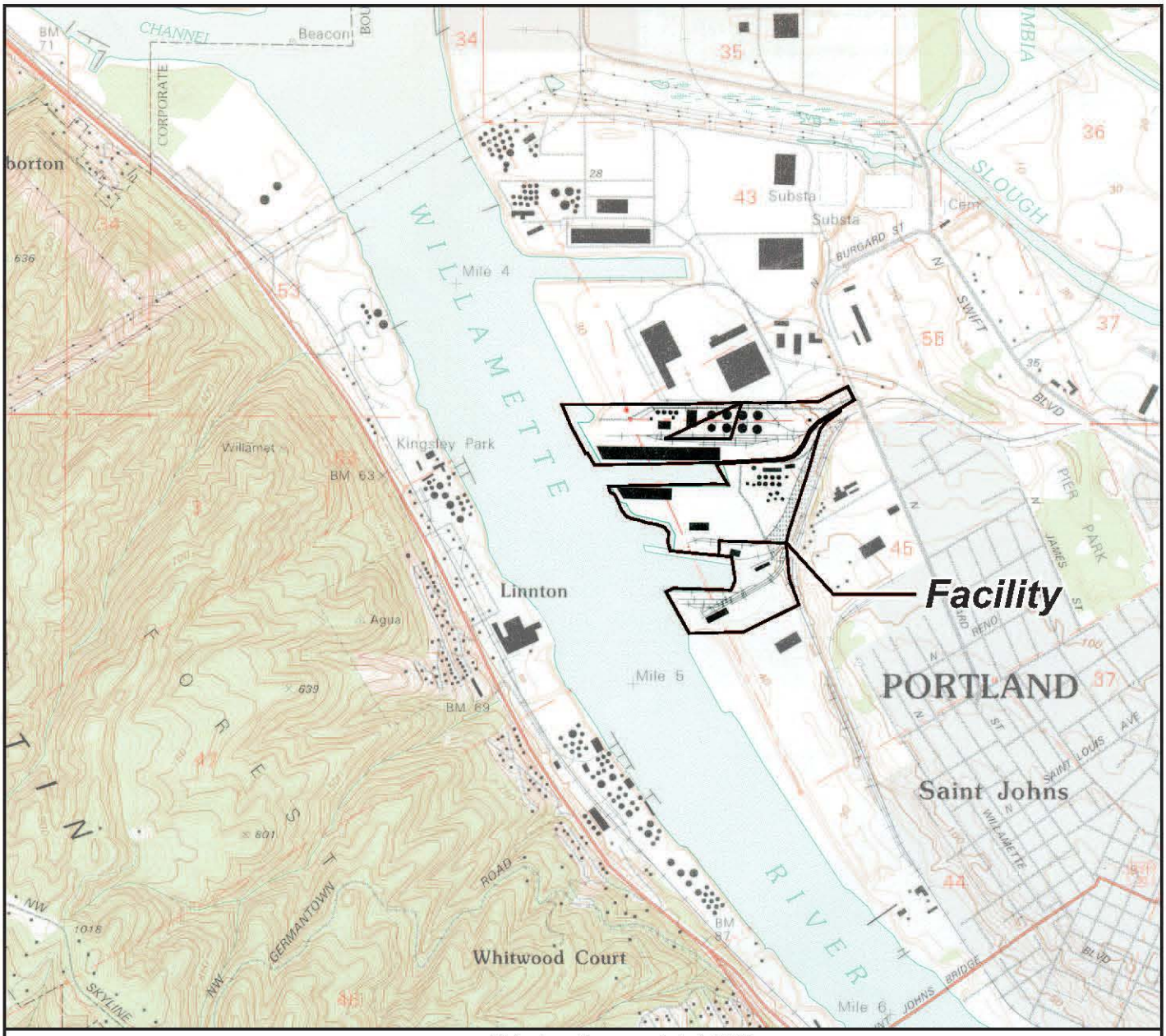
Figure 1 – Facility Location Map
Figure 2 – Stormwater Sampling Locations and Approximate Sub-Basins
Figure 3 – Sub-Basins for Evaluation

Table 1 - Terminal 4 Stormwater Sub-Basin Evaluation

			Basin L							Basin M					
			STSMH2607							STSMH2589					
UNITS			Grab	Composite	STSMH2731	STSMH2614	STSMH2613	STSMH2611	CO-1	Grab	Composite	STSMH2729	STSMH2729 RR	STSMH2720	STSMH2588
Input Values															
Velocity	**ft/s**		--	1.52	0.8	0.4	0.8	0.2	--	6.8	2.6	4	--	5	0.8
D_{pipe}	**inches**		18	18	10	21	10	21	--	15	15	10	--	18	10
X_{H2O}	**inches**		--	3.07	1.5	3	0.5	5	--	3	4.09	3	--	2	8
TSS	**mg/L**		5.6	22.2	36.5	9.4	n/a	8.6	6.8	20.8	24	13.8	2.3	22.8	10.3
As	**ug/L**		0.843	0.447	0.423	1.23	n/a	1.46	20.1	0.695	1.18	0.152	1.49	2.04	0.049
PAHs	**ug/L**		0.9979	2.4694	1.2117	1.1268	n/a	1.0458	3.343	4.272	9.147	0.2173	0.0557	11.598	1.6265
Water Flow Calculation															
Theta	**radians**		1.70	1.70	1.59	1.55	0.90	2.04	--	1.85	2.20	2.32	--	1.36	4.43
Flow area	**in^2**		28.8	28.8	7.4	30.4	1.5	63.2	--	25.2	39.0	19.8	--	15.5	67.4
Conversion	**ft^2/in^2**	0.00694	--	--	--	--	--	--	--	--	--	--	--	--	--
Flow area	**ft^2**		0.200	0.200	0.051	0.211	0.010	0.439	--	0.175	0.271	0.138	--	0.107	0.468
Water Flow	**ft^3/s**		0.3042	0.304	0.041	0.084	0.008	0.088	--	1.188	0.705	0.550	--	0.537	0.374
Conversion	**L/ft^3**	28.27	--	--	--	--	--	--	--	--	--	--	--	--	--
Water Flow	**L/s**		8.600	8.600	1.16	2.38	0.23	2.48	--	33.6	19.9	15.6	--	15.2	10.6
Common Concentration Units															
Conversion	**mg/µg**	0.001	--	--	--	--	--	--	--	--	--	--	--	--	--
As	**mg/L**		0.000843	0.000447	0.000423	0.00123	--	0.00146	--	0.000695	0.00118	0.000152	--	0.00204	0.000049
PAHs	**mg/L**		0.0009979	0.0024694	0.0012117	0.0011268	--	0.0010458	--	0.004272	0.009147	0.0002173	--	0.011598	0.0016265
Mass Flow Calculation															
$\dot{m}$	**mg/s**	TSS	48.16	190.9	42.3	22.4	--	21.3	--	698.6	478.1	215	--	346	109
		As	0.007250	0.003844	0.00049	0.00293	--	0.00362	--	0.0233	0.0235	0.0024	--	0.030949	0.000518
		PAHs	0.008582	0.02124	0.00141	0.00269	--	0.00260	--	0.143	0.182	0.0034	--	0.1760	0.0172
Conversion	**(kg/yr) / (mg/s)**	31.536	--	--	--	--	--	--	--	--	--	--	--	--	--
$\dot{m}$	**kg/yr**	TSS	1,519	6,021	1,336	707	--	673	--	22,032	15,078	6,772	--	10,908	3,436
		As	0.229	0.121	0.015	0.092	--	0.114	--	0.736	0.741	0.075	--	0.976	0.016
		PAHs	0.271	0.670	0.044	0.085	--	0.082	--	4.525	5.747	0.107	--	5.549	0.543

Notes:

1. Shading indicate that depth and velocity from the ISCO auto-sampler was used.



Base map prepared from the USGS 7.5-minute quadrangle of Linnton, Oregon, dated 1990.

0 2,000 4,000

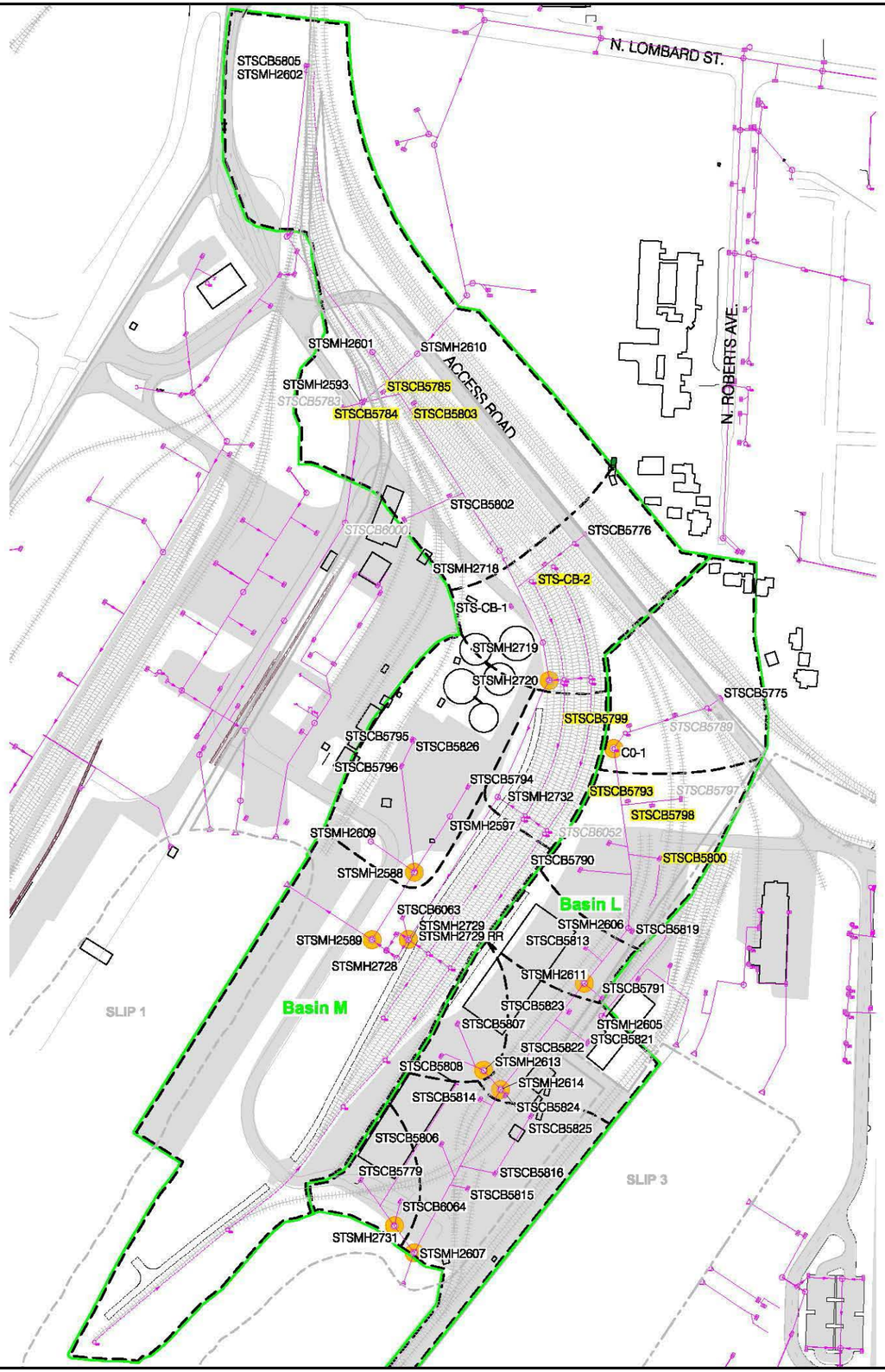
Approximate Scale in Feet

Facility Location Map

Stormwater Sub-Basin Sampling Results Evaluation
Terminal 4 Slip 1 Upland Facility
Portland, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	1267	Figure
September 2014		1



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Legend:

- Drainage Basin Boundary
- Slip 1 Operating Unit Boundary as Defined by Ordinary Low Water Level (1.7 Ft. CRD)
- Slip 1 Operating Unit Boundary - Upland
- Slip 3 Unit Boundary
- Asphalt or Concrete Pavement
- Underground Stormwater Conveyance System Piping (High Density Perforated Polyethylene Pipe, Where Dashed)
- Stormfilter Treatment Vault Location
- Oil Water Separator Location
- STSCB5775 — Inlet Location and Identification (Basins L and M Only)
- C0-1 — Cleanout Location (Only Sampled Location is Identified)
- Drain Location
- STSMH2611 — Manhole Location and Identification (Basins L and M Only)
- Manhole/Inlet Location
- Sample Location
- Sub-Basin (Approximate)
- STSCB5799 — Inlet with Observed Side Grates Within Railroad Ballast
- *STSCB5789* — Inlet Not Found

NOTES:

1. Base map prepared from Port of Portland AutoCAD file, provided 7-2013.
2. Horizontal Datum: State Plane Coordinates, Oregon North, NAD 83. Vertical Datum: NVGD 29.
3. City outfall 52-C not shown.

N

0 300 600

Scale in Feet

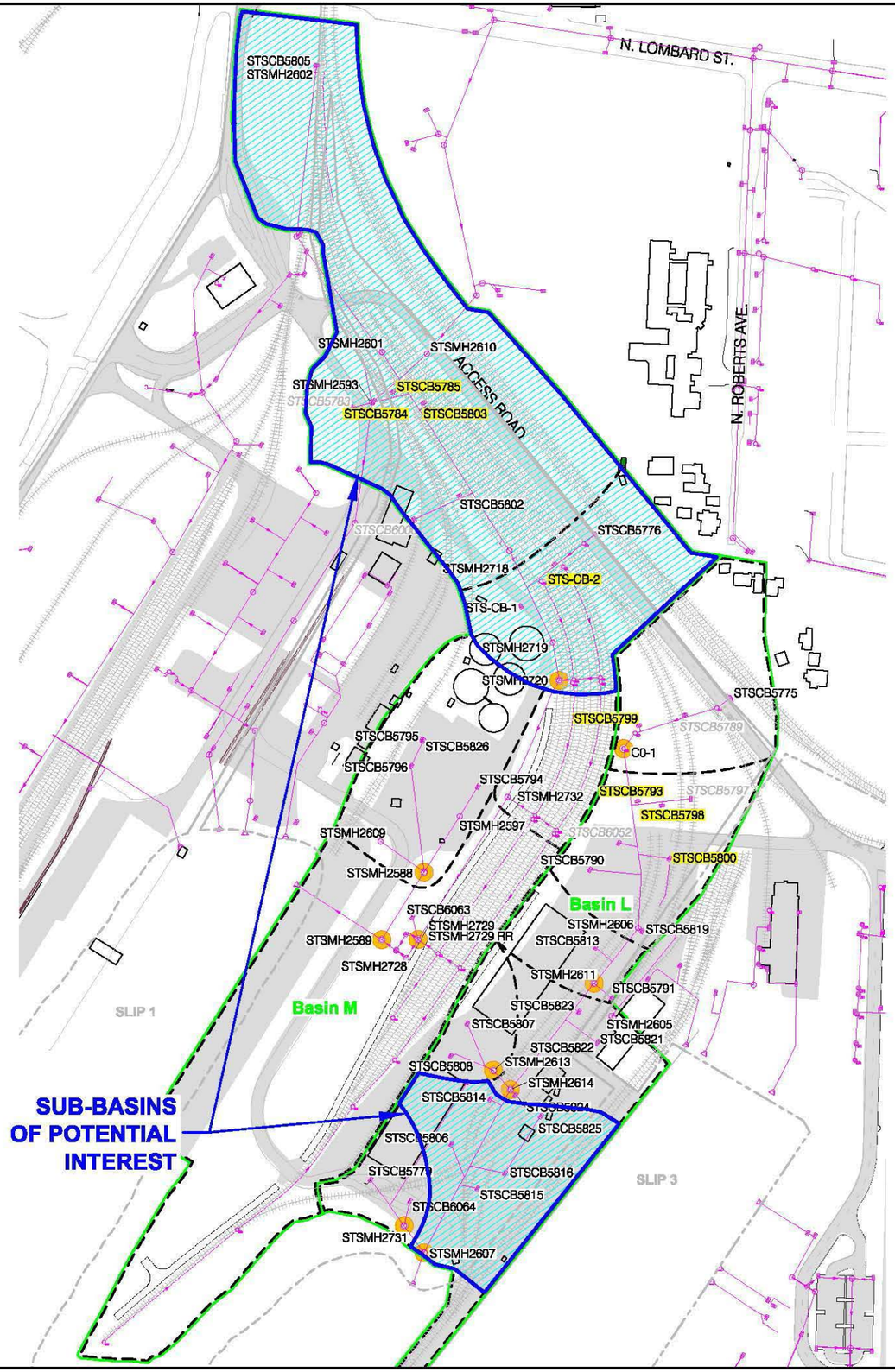
Stormwater Sampling Locations and Approximate Sub-Basins

Stormwater Sub-Basin Sampling Results Evaluation

Terminal 4 Slip 1 Upland Facility

Portland, Oregon

APEX Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201	Project Number	1267	Figure 2
	September 2014		



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Sub-Basins For Evaluation

Stormwater Sub-Basin Sampling Results Evaluation
Terminal 4 Slip 1 Upland Facility
Portland, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

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